Emmons & Olivier Resources, Inc.

The Agricultural BMP Handbook for Minnesota

Mississippi River Forum– 1/25/2012

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w a t e r | e c o l o g y | c o m m u n i t y

Topics – 30-Minute Presentation

What is the Handbook?

How can I use the Handbook?

Where can I get the Handbook?

Handbook History

1985, Pre-history

2009, Legacy Amendment

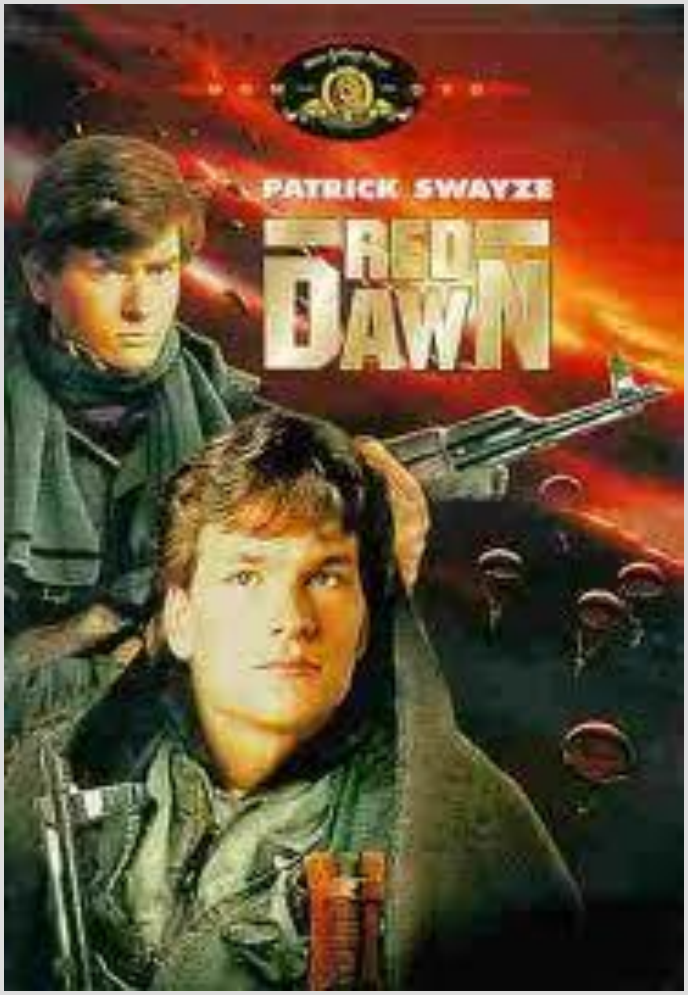
2011, The MDA appropriated money through a competitive RFP process

Then and Now

1985…

Then and Now

1985…



2012…

Then and Now

1985…

2012…

Then and Now

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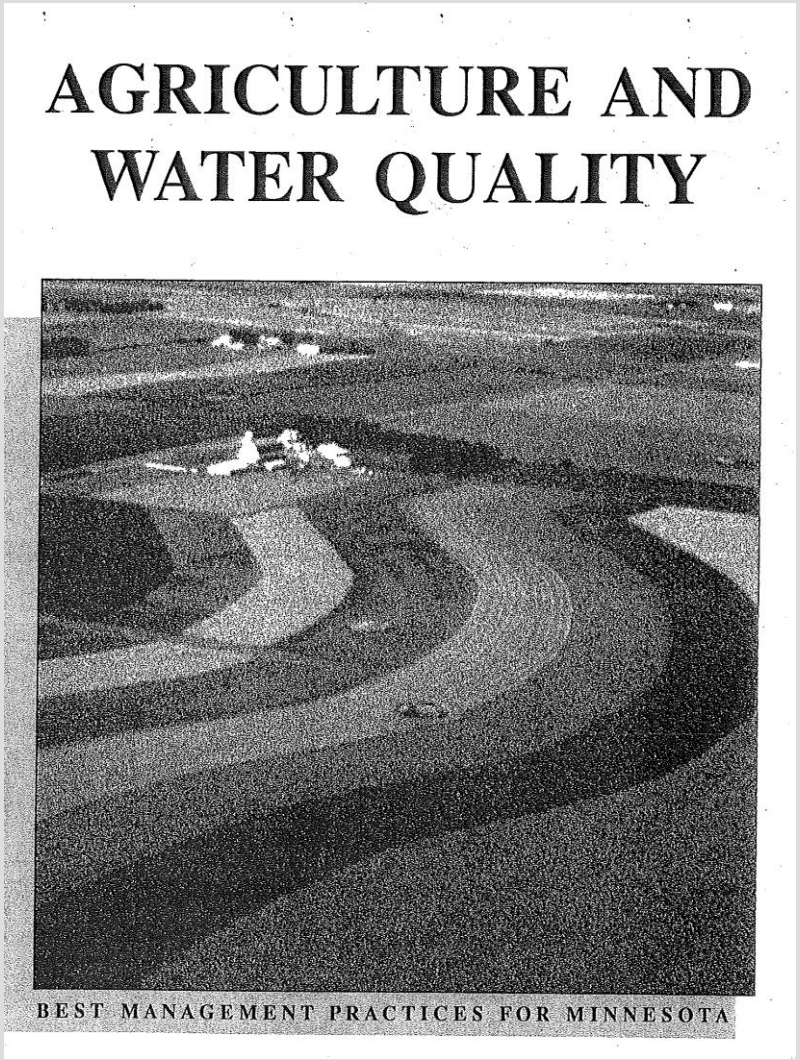
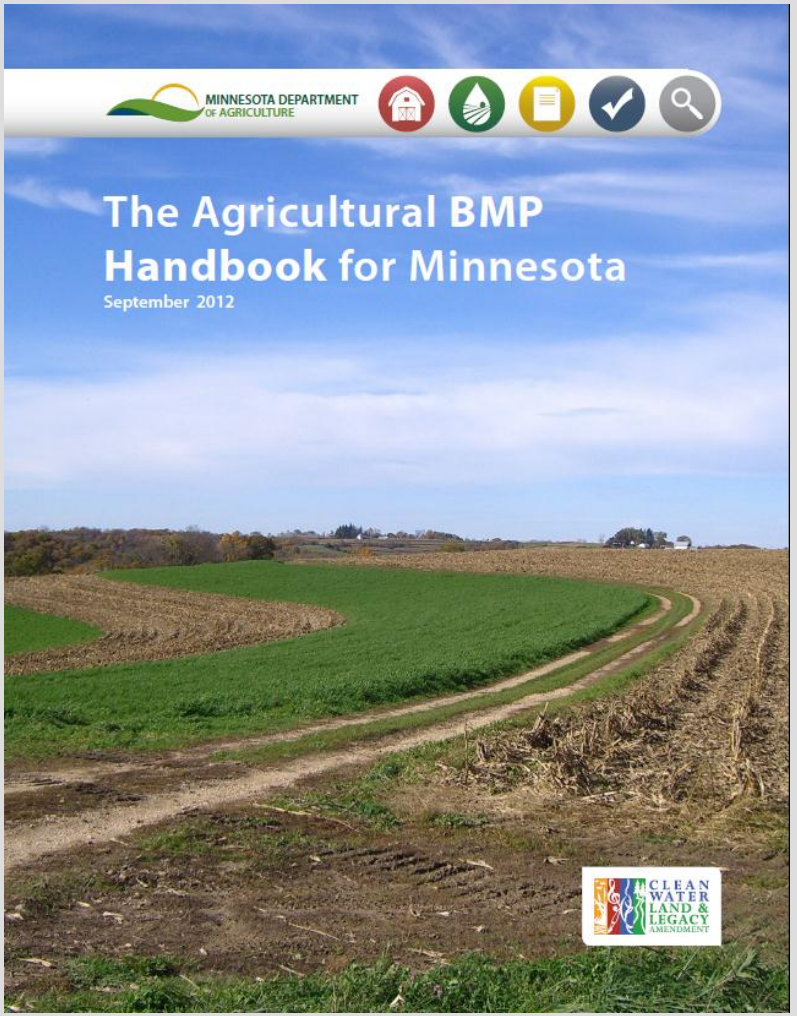


2012…



Handbook Overview

- 1st State Handbook based on research
  - Compilation of the 32 most important Ag-BMPs for water quality in Minnesota
- 160 Pages of Information
  - 422 Item Bibliography
  - Conservation Programs
  - Pollutants of Concern

Who's it for?

- State Agency Project Managers (PCA, MDA)
- Researchers
- Policy Makers
- Consultants
- Water Quality Stakeholders (Public)
- Water Quality Practitioners (SWCDs)

What's Inside?

- Pollutant Removals
- Design Tips
- Operation and Maintenance
- Cost information
- References and Links!!!
- Appendices

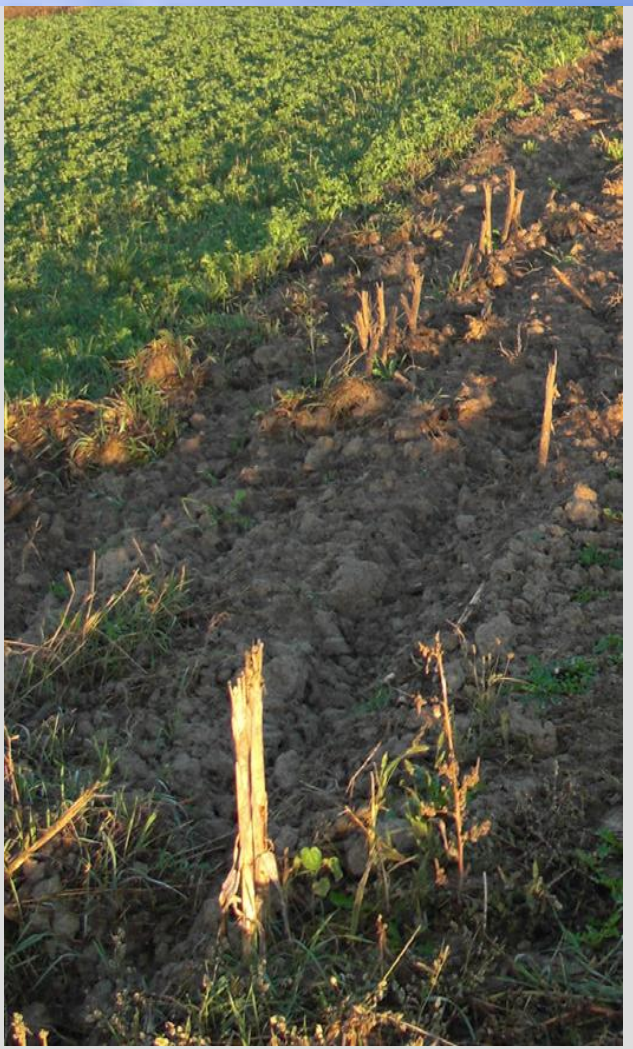
Sources of Handbook Information

1. Peer-reviewed research articles
2. Technical manuals & guidance
3. Agency funded research reports
4. Unpublished research

Handbook Organization

MINNESOTA DEPARTMENT OF AGRICULTURE

- Introduction
- Water Quality in Agricultural Watersheds
- Agricultural BMPs
- BMP Chapters
- Appendices



BMP Chapters

MINNESOTA DEPARTMENT OF AGRICULTURE

Role in Conservation

1. Avoiding
2. Controlling
3. Trapping

Mississippi River Basin Healthy Watersheds Initiative (MRBI)

Inside the 40 BMP Chapters

Agricultural BMP: Cover Crop

AVOIDING

Cover crop, Washington County, MN

Cover Crops (340)

Definition & Introduction

Cover Crops as a BMP refers to the use of grasses, legumes or forbs planted to provide seasonal soil cover on cropland when the soil would otherwise be bare. In Minnesota, the cover crop is commonly rye, although oats, barley, alfalfa, buckwheat and hairy vetch are also used. The short growing season in Minnesota limits the use of cover crops although use is expanding as farmers are seeing the environmental and financial benefits of the practice.

The MDA categorizes cover crops into 5 main categories with winter cover crops and catch crops being the most commonly used (MDA, website):

- A **winter cover crop** is planted in late summer or fall to provide soil cover over winter. In Minnesota, winter cover crops are commonly planted after potato harvest primarily to reduce wind erosion.
- A **catch crop** is a cover crop planted after harvesting the main crop, primarily to reduce nutrient leaching. Many southeastern Minnesota growers use cover crops in this way and are cooperating with the Minnesota Department of Agriculture on related research and demonstration projects.
- A **smother crop** is a cover crop planted primarily to outcompete weeds. In Minnesota, buckwheat and rye cover crops commonly serve this purpose.
- A **green manure** is a cover crop incorporated into the soil while still green, to improve soil fertility. Currently in Minnesota, green manures are used primarily by organic growers.

- **Role in Conservation**
- **Definition**
- **Link to eFOTG**
- **Image of practice**

Inside the 40 BMP Chapters

Agricultural BMP: Cover Crop

- Cover crops can serve as **short-rotation forage crops** when used for grazing or harvested as immature forage (green chop).

Water Quality & Other Benefits

Water quality benefits of cover crops come from three processes. The first is the literal cover that the crop provides to the soil, reducing erosion from raindrop impact. The second is the potential for the cover crop to take up nutrients that would otherwise be lost from the field through surface or drainage water and the third is increasing soil infiltration.

Minnesota has pioneered cover crop research in northern climates. A 3 year study at Lamberton, MN (Strock et al., 2004) subsurface tile drainage discharge was reduced 11% with a cover crop and that nitrate loss was reduced 13% on a corn-soybean cropping system. These results show a much lower reduction than has been reported around the nation and it has been hypothesized that the reduced effectiveness in Minnesota is due to the short growing season and cold climate (Kaspar, 2008).

An additional study in southwestern Minnesota (Feyereisen et al., 2006) based on modeling concluded that a rye cover crop planted on September 15 and desiccated on May 15 can reduce nitrate losses on average of 6.6 lbs/ac (7.4kg/ha). The other regional example of research is from central Iowa where researchers found a nitrate load reduction of 61% for rye cover crop (Kaspar et al., 2007). Jaynes et al. (2004) showed that a cover crop treatment in Minnesota reduced nitrate load by 64% over the control. In a large soil monolith study in Iowa, Logsdon et al. (2002) showed rye cover crop and oat cover crop both reduced nitrate leaching and they recommended late-summer, interseeded small-grain cover crops to reduce nitrate losses from corn-soybean rotations.

Key Design/Implementation Considerations

Cover crops can be used to reduce erosion, hold nutrients and/or provide forage. An excellent factsheet published by the MDA provides a good summary of conditions where farmers are deploying cover crops and can be used as a starting point for designing a cover cropping system (Figure 2). Although this figure shows Winter Rye as the primary cover crop, a large variety of cover crops exist including varieties of grasses, legumes, and brassicas. The Midwest Cover Crop Council has developed a decision tool that can inform planting times and species for specific farms in Minnesota. http://www.mccc.msu.edu/

Cover Crops are often used on beet fields and have become part of the southern MN Beet Growers cooperative P trading program. A precedent-setting program where a co-op provided financial incentives for farmers to use cover crops. http://www.smbsc.com/.

Cost Information

The EQIP payment for cover crops is $40.00/ac.

Table 10. 2011 EQIP payment schedule (reproduced from MN NRCS 2011)

Component	Unit	PR/unit	HUP/unit	Payment Cap
Legumes or mixed covers on cropland	ac	40	48	$7,000
Small grain seeding	ac	16	19	$6,000

- **Water Quality Benefits**
- **Key Design Information**
- **Costs**

Inside the 40 BMP Chapters

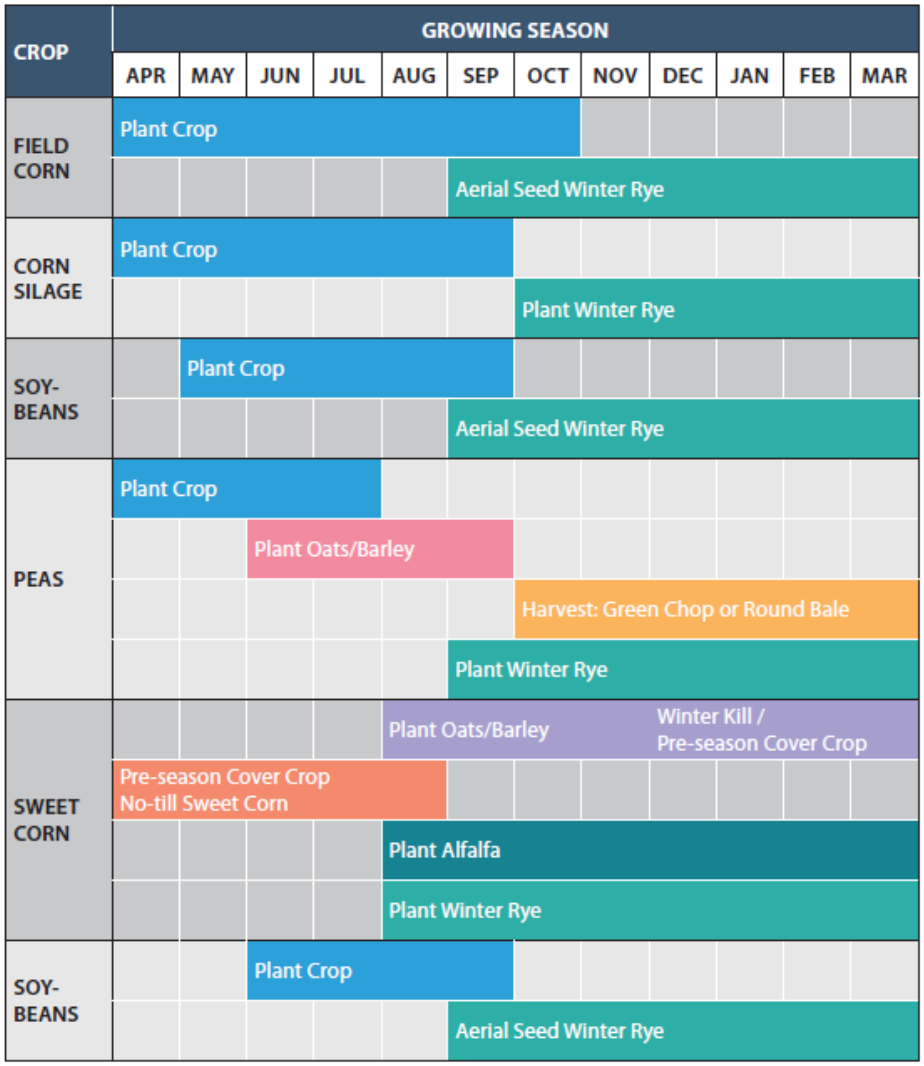
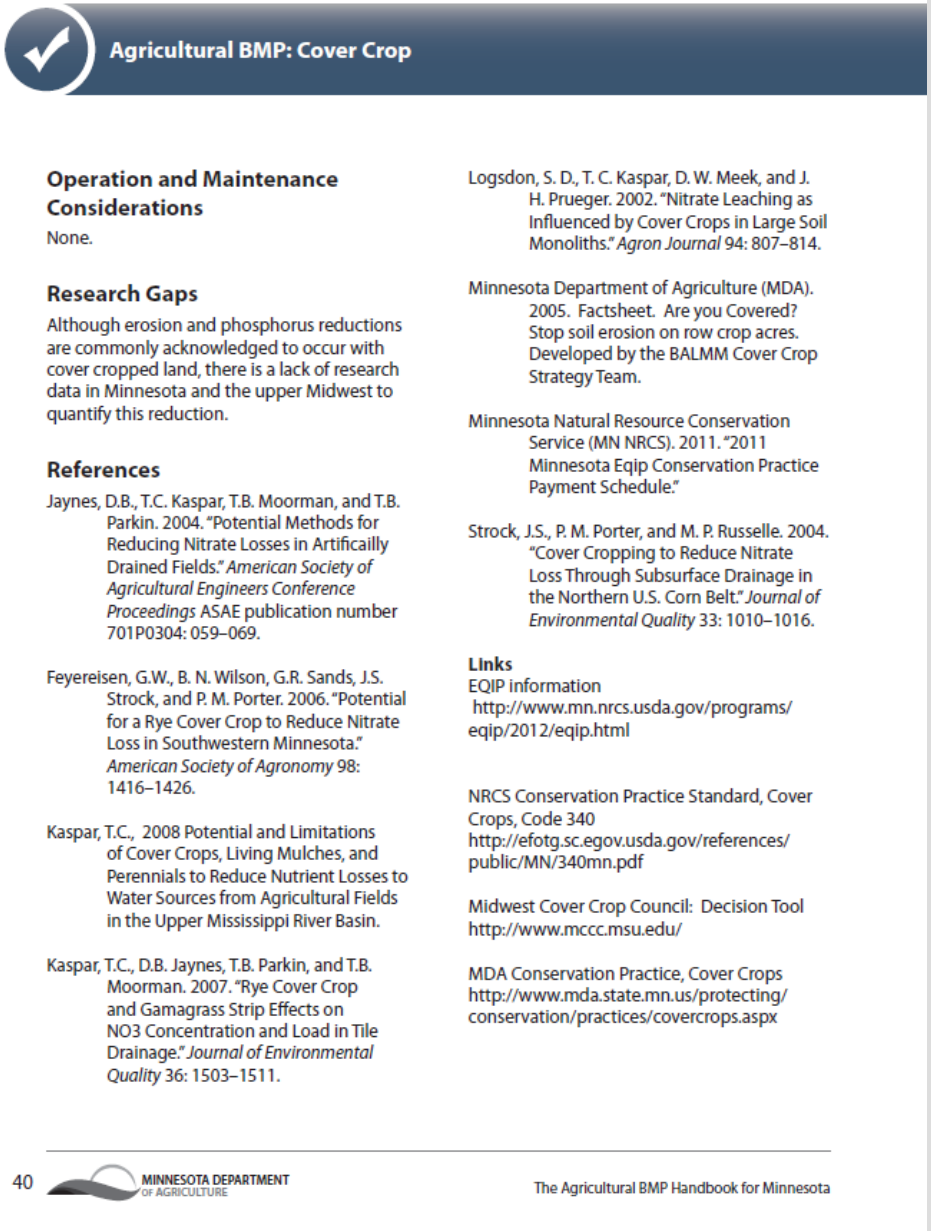


Figure 2. Cover crop uses and timeline by crop type. (adapted from MDA 2005)

- **Important resources have been reproduced**

Inside the 40 BMP Chapters



Agricultural BMP: Cover Crop

Operation and Maintenance Considerations

None.

Research Gaps

Although erosion and phosphorus reductions are commonly acknowledged to occur with cover cropped land, there is a lack of research data in Minnesota and the upper Midwest to quantify this reduction.

References

Jaynes, D.B., T.C. Kaspar, T.B. Moorman, and T.B. Parkin. 2004. "Potential Methods for Reducing Nitrate Losses in Artificailly Drained Fields." *American Society of Agricultural Engineers Conference Proceedings* ASAE publication number 701P0304: 059–069.

Feyereisen, G.W., B. N. Wilson, G.R. Sands, J.S. Strock, and P. M. Porter. 2006. "Potential for a Rye Cover Crop to Reduce Nitrate Loss in Southwestern Minnesota." *American Society of Agronomy* 98: 1416–1426.

Kaspar, T.C., 2008 Potential and Limitations of Cover Crops, Living Mulches, and Perennials to Reduce Nutrient Losses to Water Sources from Agricultural Fields in the Upper Mississippi River Basin.

Kaspar, T.C., D.B. Jaynes, T.B. Parkin, and T.B. Moorman. 2007. "Rye Cover Crop and Gamagrass Strip Effects on NO3 Concentration and Load in Tile Drainage." *Journal of Environmental Quality* 36: 1503–1511.

Logsdon, S. D., T. C. Kaspar, D. W. Meek, and J. H. Prueger. 2002. "Nitrate Leaching as Influenced by Cover Crops in Large Soil Monoliths." *Agron Journal* 94: 807–814.

Minnesota Department of Agriculture (MDA). 2005. Factsheet. Are you Covered? Stop soil erosion on row crop acres. Developed by the BALMM Cover Crop Strategy Team.

Minnesota Natural Resource Conservation Service (MN NRCS). 2011. "2011 Minnesota Eqip Conservation Practice Payment Schedule."

Strock, J.S., P. M. Porter, and M. P. Russelle. 2004. "Cover Cropping to Reduce Nitrate Loss Through Subsurface Drainage in the Northern U.S. Corn Belt." *Journal of Environmental Quality* 33: 1010–1016.

Links

EQIP information
http://www.mn.nrcs.usda.gov/programs/eqip/2012/eqip.html

NRCS Conservation Practice Standard, Cover Crops, Code 340
http://efotg.sc.egov.usda.gov/references/public/MN/340mn.pdf

Midwest Cover Crop Council: Decision Tool
http://www.mccc.msu.edu/

MDA Conservation Practice, Cover Crops
http://www.mda.state.mn.us/protecting/conservation/practices/covercrops.aspx

- Operation and Maintenance
- Research Gaps
- References
- Links

Appendices

Minnesota and Upper Midwest BMP Matrix

This resource matrix was compiled from empirical studies of BMP effectiveness in Minnesota and the Upper Midwest.

Table 32. Upper Midwest and Minnesota BMP Research

AVOIDING								
BMP	Turbidity/ Sediment	Phosphorus	Soluble Phosphorus	Nitrogen/ Nitrates	Ammonia	Pesticides	Bacteria	Dissolved Oxygen
Conservation Cover (327)	Christenson et al., 2009	Mohring and Christensen, ongoing		Christenson et al., 2009; Randall et al., 1997; Huggins et al., 2001				
Conservation Crop Rotation (328)				Huggins et al.,2001; Randal et al., 1997; Randal et al., 1993; Oquist et al., 2007				
Contour Buffer Strips (332)	Arora et al., 1996					Arora et al., 1996		
Contour Farming (330)								
Cover Crops (340)				Feyereisen et al., 2006; Strock et al., 2004 Kaspar, 2008; Kaspar et. al, 2007; Jaynes et al., 2004; Logsdon et al., 2002				
Grade Stabilization (410)								
Livestock Exclusion/ Fencing (382 and 472)								

Appendix A: Minnesota and Upper Midwest Research

Appendices

Other BMP Research from National Sources and Modeling

Many national sources of information regarding effectiveness of agricultural BMPs exist. The following chapter presents research conducted on BMPs outside of Minnesota and the Upper Midwest, selected modeling studies and compilations of BMP effectiveness from national sources. This information may or may not be applicable to Minnesota and Upper Midwest due to climatic, crop and soil differences. This chapter aims to capture much of the important national research and modeling information that didn't fit the criteria for inclusion in the BMP chapters. This chapter follows the same order as the BMP chapters and is separated into avoiding, controlling and trapping.

Avoiding

Conservation Cover
No additional commentary.

Conservation Crop Rotation
The impacts of conservation crop rotation on erosion and phosphorus loss are likely due primarily to the benefit of having the land in perennials for the year. National sources (Merriman, 2009) list the pollutant reduction of sediment and TP as 72% and 60%, respectively, although the relevance of this figure to Minnesota has not been shown.

Table 33. Pollutant reduction estimates in percent for contour buffer strips.

Pollutant	Mean	Minimum	Maximum	Number of Entries	Number of Entries	Source
Total Sediment	78%	30%	94%	20	12	1, 2, 3
Total Phosphorus	62%	49%	80%	11	10	2, 3
Dissolved Phosphorus*	34%	20%	50%	11	9	2, 3
Total Nitrogen	36%	27%	50%	8	8	3
Dissolved Nitrogen	31%	18%	49%	31	8	3
Fecal Coliform	59%	43%	74%	22	2	1

1 – Coyne et al., 1995 2 – Daniels and Gilliam, 1996 3 – Schmitt et al., 1999

* an outlier in Daniels and Gilliam, 1996 was excluded from the dataset; it reported a 240% increase in dissolved phosphorus in one case

Appendix B: National Sources

Appendices

Annotated Bibliography

This bibliography is a comprehensive list of resources reviewed during development of this handbook. It includes local and national sources of empirical and modeling data, background information and industry standards. Some of the resources listed in this bibliography were not reported in the body of the handbook but have been included in the bibliography as additional information for the reader.

Appendix C: Bibliography

Effectiveness of vegetated buffer strips in reducing pesticide transport in simulated runoff

Type	Journal Article
Author	K. Arora
Author	S. K. Mickelson
Author	J. L. Baker
Publication	Transactions of the American Society of Agricultural Engineers
Volume	46
Issue	3
Pages	635-644
Date	2003
Extra	Iowa, Ames

Tags:

agricultural best management practice buffer contour stripcropping filter strip grassed waterways nutrient management riparian forest buffer

Notes:

This paper describes a good research project using a controlled runoff experiment to estimate pesticide reduction across a buffer strip. It also provides a good summary of previous work on buffer strip pollutant removals. It shows pesticide removals of 46.8%-83.1%.

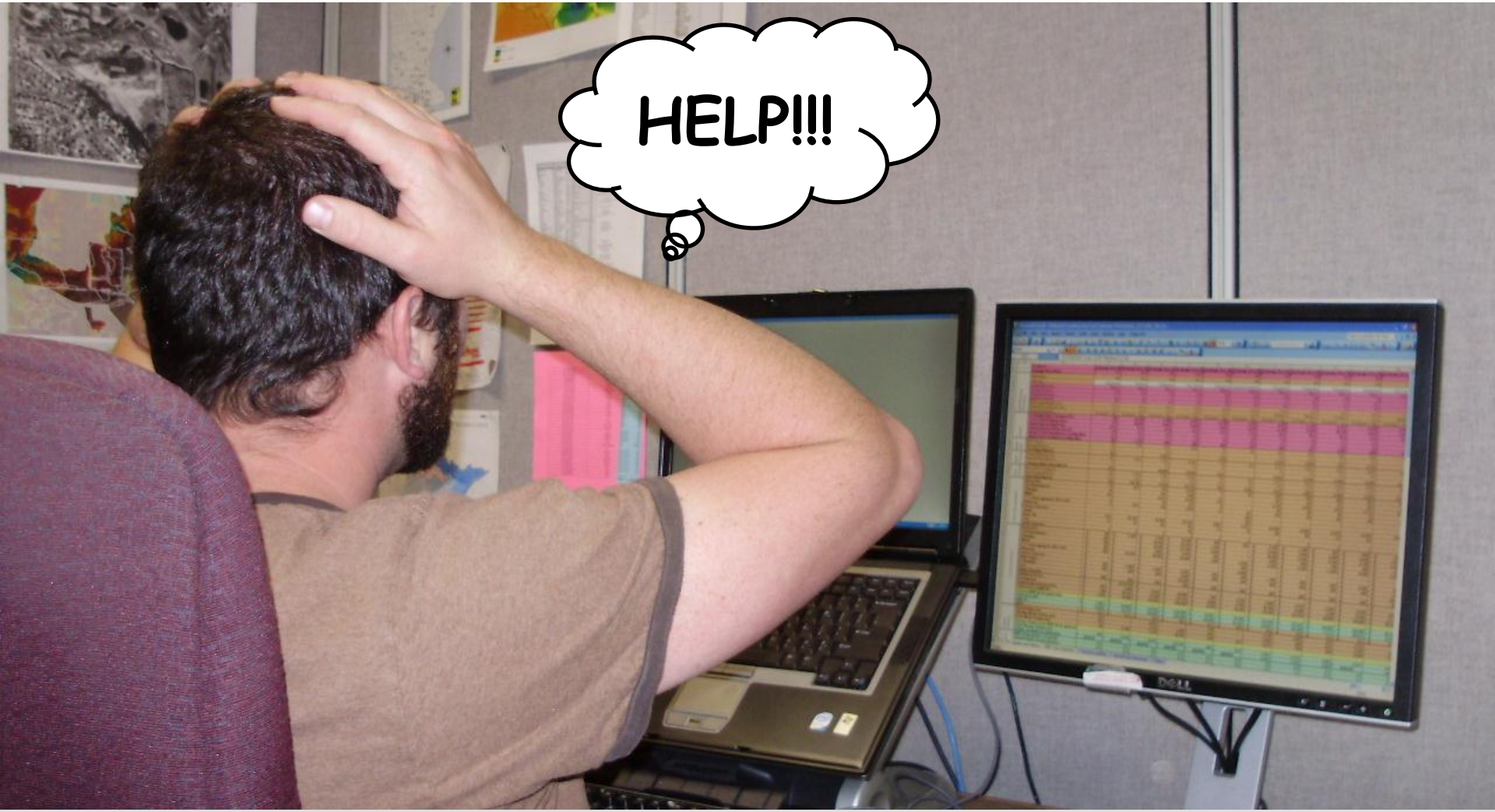
How can I use the handbook?

- **Communication**
- **Planning**
- **Research**

3 Short Examples

1. **Pollutant Removals**
2. **Research/Demonstration Projects**
3. **Implementation Planning**

Example 1 – Pollutant Removals



I need to estimate phosphorus reduction for this Clean Water Fund grant application I'm working on!

Example 1 – Pollutant Removals

Table 25. Pollutant load reduction estimates in percent for filter strips

Pollutant	Mean	Minimum	Maximum	Number of Entries	Source
Sediment	86	76	91	6	1
Total Phosphorus	65	38	96	4	2, 3
Nitrogen	27	27	27	1	3
Atrazine	58	45	71	6	1
Metolachlor	72	68	78	6	1
Cyanazine	69	59	77	6	1

1 – Arora et al., 1996
2 – Webber et al., 2009
3 – Eghball et al., 2000

Installing Filter Strips

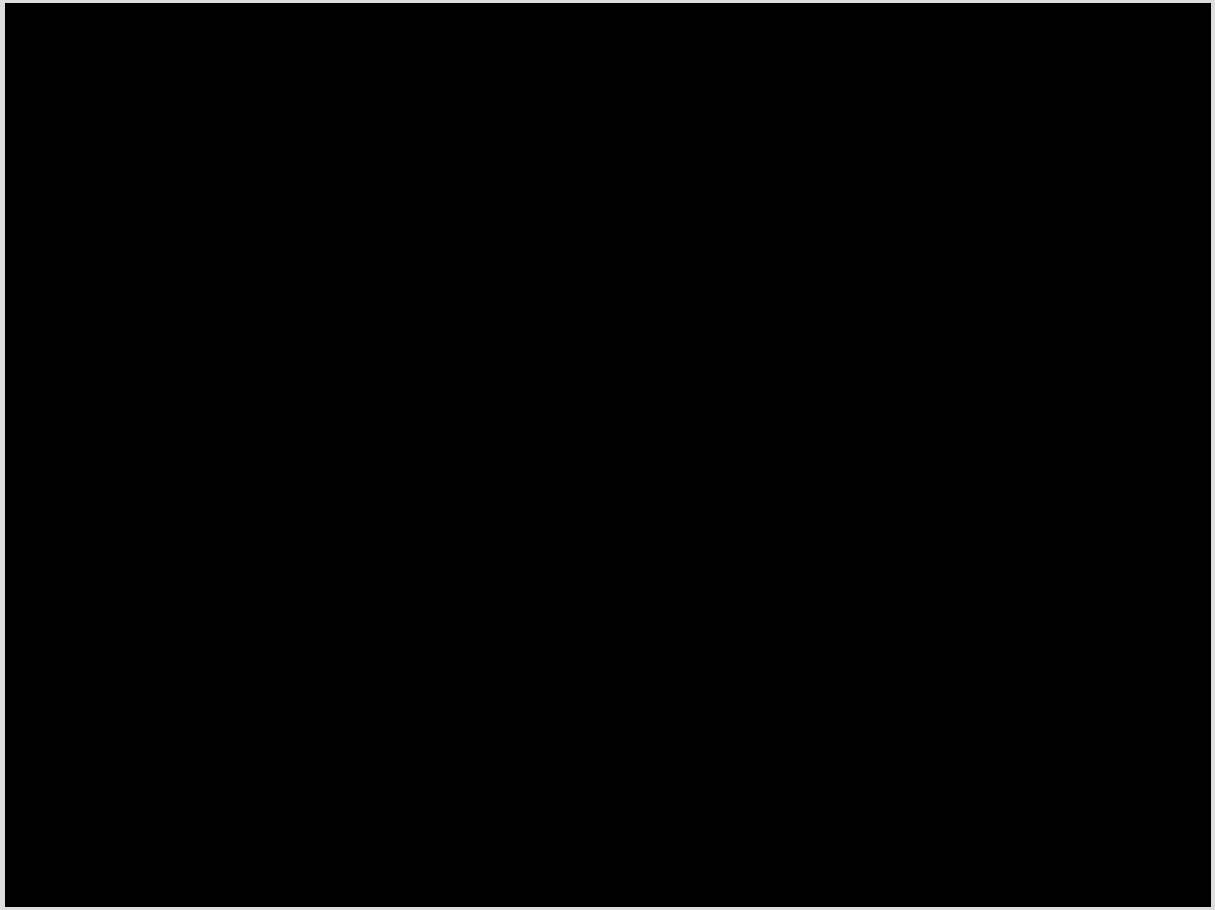
1. Go to the Filter Strip chapter on Page 125.
2. READ the chapter!
3. Select the reference that is most similar to your situation
4. Use that value in your BWSR calculator or other model instead of defaults

Example 2 – Research and Demonstration Projects

New(er) conservation practices

Woodchip Bioreactors

Controlled Drainage



From: *Managing Water. Harvesting Results.* A production of H2O videos. (2011)

Example 2 – Research and Demonstration Projects

Plan effectively without a NRCS practice code

Write tailored proposals

Example 3 – TMDL and WRAP Studies

1. Identify Pollutants
2. Figure out how to Reduce Pollutants
3. Implement Conservation
4. Go Swimming

Example 3 – TMDL and WRAP Studies

Communication

Consultants – Counties

1. Identify Pollutants

Consultants – Counties – PMs – Citizen Groups

2. Figure out how to Reduce Pollutants

Consultants – Counties – PMs – Citizen Groups – Farmers – landowners

3. Implement Conservation

Consultants – Counties – PMs – Citizen Groups – Farmers – landowners - EVERYBODY

4. Go Swimming

Where do we go from here???

Minnesota Agricultural Water Quality Certification Program

Under the program, farmers would voluntarily implement and maintain approved conservation plans and receive assurance that their operations meet water quality goals and standards. In return, they would not be required to implement additional water quality practices for the duration of their certification.

St. Cloud: Thursday, February 28, 1:00 – 3:00 p.m., MNDOT Training Center

Download The Agricultural BMP Handbook for Minnesota

www.eorinc.com

Click on “Bulletin Board”

Acknowledgements

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Thank You

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